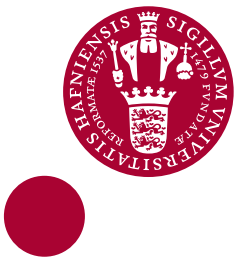

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Lessons Learned from Crime Caught on Camera

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Abstract

Objectives: The widespread use of camera surveillance in public places offers criminologists the opportunity to systematically and unobtrusively observe crime, their main subject matter. The purpose of this essay is to inform the reader of current developments in research on crimes caught on camera. *Methods:* We address the importance of direct observation of behavior and review criminological studies that used observational methods, with and without cameras, including the ones published in this issue. We also discuss the uses of camera recordings in other social sciences and in biology. *Results:* We formulate six key insights that emerge from the literature and make recommendations for future research. *Conclusions:* Camera recordings of real-life crime are likely to become part of the criminological tool kit that will help us better understand the situational and interactional elements of crime. Like any source, it has limitations that are best addressed by triangulation with other sources.

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CCTV, interaction, observational methods, camera footage

Scientific progress is often the result of technological developments that enlarge our observational capabilities, not only in the natural sciences but also in the social and behavioral sciences. Two recent examples of technological developments that have facilitated scientific advances are the functional magnetic resonance imaging (fMRI) scanner and the smartphone (Raento, Oulasvirta, and Eagle 2009).

An MRI is a noninvasive technique to measure brain activity, and fMRI scanners allow researchers to measure activity in all regions of the brain during controlled experiments. The technique provides unprecedented opportunities for advancement in neuropsychology (Bennett et al. 2016; Casey 2002).

Raento et al. (2009) argue that the development of the smartphone promises to become an equally revolutionary opportunity for progress in the social sciences. The device is willingly carried by many people and contains numerous functions for communication and unobtrusive automated observation of everyday social and spatial behavior. In fact, the geotracking feature of the mobile phone already spurred important advances in social geography, where daily human mobility patterns have been discovered by tracking the whereabouts of phone users on a massive scale (Gonzalez, Hidalgo, and Barabasi 2008; Song et al. 2010).

This special issue is devoted to the potential of another piece of technology, the camera, to facilitate progress in criminology. In biology, the camera has already proven its value. Rapid improvements of camera technologies since the 1990s made it possible to unobtrusively observe animals in their natural habitat using camera traps (O'Connell, Nichols, and Karanth 2011). Camera traps are cameras activated by motion or infrared sensors. The footage has provided biologists with new insights data on movement, foraging, bonding, and about conflicts previously seldom observed, such as nest predation (Kucera and Barrett 2011).

A closed-circuit television (CCTV) camera is a camera trap that runs continuously, not in the bush but in human environments. The presence of camera surveillance in public, semipublic, and private spaces has become a widespread and increasing phenomenon. We expect that the widespread use of high-quality CCTV cameras—often situated in places where it is possible to observe crime in action—will considerably enrich our understanding of crime in the near future.

This concluding essay is meant to provide arguments that support this prediction and to provide some guidance in how to use video recording in crime research. It is structured as follows. We commence by addressing the importance and difficulties of direct observation of behavior in research on crime, and continue with an overview of criminological studies that used observational methods but did not involve camera-recorded observations. The section that follows reviews the uses of camera footage in other fields, including biology and the social sciences. In the subsequent section, we discuss a handful of prior studies that had used camera footage to analyze crime. We end the essay by formulating six "lessons learned" from the contributions to this special issue and by making recommendations that follow from these lessons.

Observing and Measuring Crime

Criminologists rarely observe criminal behavior directly. What we know about crime is usually based on what we are told, but not on what we see. There are various reasons for the lack of observational data on crime including the rarity of crime and the ethical requirement of preventing it when possible. The most important reason for not observing crime directly might be the fact that those who commit it attempt to hide their behavior because it is disapproved and sanctioned.

Biases in Nonobservational Data

Without the possibility to directly and systematically observe crime, we run the risk that the most basic information about our subject matter will be incomplete or biased. The methods that have been used in studies of crime all have their advantages and disadvantages, but what they have in common is that the measures of criminal behavior they provide are not based on direct observation of the behavior.

Police records have been used to obtain detailed information on behavior during crime events (e.g., Ganpat, van der Leun, and Nieuwbeerta 2013; Weenink 2014). At best, however, they provide multiple accounts of the event by suspects, victims and witnesses, but it is well known from the extant literature on the psychology of law that such accounts tend to be unreliable (Vrij, Hope, and Fisher 2014). They are retrospective accounts biased by cognitive limitations of the participants and likely to be influenced by the fact that offenders, victims, and bystanders expect their accounts will influence decisions made by law enforcement agents.

Other sources of information on crime, such as surveys and interviews (e.g., Beauregard and Leclerc 2007; Jacques and Wright 2015), likewise depend on verbal or written accounts of the persons involved in crime as offenders, victims, or witnesses. Although in these cases the accounts of the respondents might not be driven by an incentive to influence the processing of the criminal case, they may still be biased because of imperfections in human memory and because of social desirability tendencies. Participant observation is a method that provides at most limited opportunities to observe crime, in particular forms of crime that are relatively mild (such as spraying graffiti) or consensual (such as drug use or prostitution), but it is not used intensively in criminology (Lindegaard and Copes 2017).

Overcoming Bias

Admittedly, the limitations of single sources of information can be overcome to some extent by combining different methods of data collection (triangulation through mixed methods), as it allows researchers to verify that findings of multiple methods and data sources correspond with each other (Lindegaard 2010).

Mixed-method research and triangulation of research findings are not common in criminology, though. In reviewing measurement of crime and delinquency over five decades, Sullivan and McGloin (2014) identified an imbalance in contemporary criminology between an increasing sophistication of analytical models and a relative stagnation in the further development of measurement techniques. As part of six recommendations for improvement, they proposed that criminology come up with alternatives to self-report studies by developing measurement triangulation and by borrowing measurement techniques from other fields.

This special issue addresses another way of improving the validity of measuring crime: CCTV camera recordings of crime in natural settings. This method of measuring crime implies returning to the basics of observation by literally seeing crime in the making, but it also allows for major improvements. For example, with CCTV recordings, we can observe the same event repeatedly, we can have it observed by multiple researchers, we can play it back in slow motion, and the raw material can be documented and archived for later use. These improvements have the potential of reactivating the use of observational methods in studies of crime.

Crime in Action

The overall focus in this special issue is on real-life crime in action that has been captured on camera. The term "crime in action" emphasizes that the contributions focus on the tangible criminal acts perpetrated by offenders and on their interactions with victims and bystanders. The phrase crime in action has been used previously in studies of robbery and burglary (Wright and Decker 1994, 1997) and of guardianship (Reynald 2009). These studies, and many other studies that did not use the phrase, did also aim to get insights into actual behavior during criminal events. However, they relied on interviews, experiments, and police case files, whereas the contributions in this special issue rely on video footage.

Despite a general acknowledgment that even the most crime prone people are not committing crime all the time (Collins 2008), most explanations of crime focus on personal characteristics of the people involved rather than on characteristics of the particular circumstances that stimulate criminal behavior. Self-report studies, and to some extent police case files as well, are better suited to measure personal characteristics than situational characteristics (Ganpat et al. 2013). CCTV recordings, however, can sometimes be used to measure both personal and situation characteristics and to compare their relative importance. For example, to examine the rate of shoplifting and the types of people committing it, Dabney, Hollinger, and Dugan (2004) used footage from covertly installed CCTV cameras in a suburban retail drug store. They found not only that no less than 8.5 percent were seen shoplifting but also that behavioral cues of shoplifting intent (scanning the store to check whether someone is watching, tampering with products, and keeping track of security measures) and leaving the store without making a purchase were much better predictors of shoplifting than age, race, social class, and other personal characteristics of the customers.

CCTV Contributions to Theory

The main theoretical potential of video recordings is that they allow scholars to test more detailed and more sophisticated situational explanations for crime. We propose that the most obvious contributions are related to routine activity theory, situational transaction theory, and situational crime prevention.

Routine activity theory focuses on variations in opportunities for crime. Definitions of opportunity have mainly been based on relatively enduring characteristics of places and persons. CCTV recordings can record changes

in opportunity on very detailed spatial and temporal scales and test whether they have the predicted effect (e.g., test whether potential thieves exploit temporary reductions in surveillance). CCTV recordings can also document relevant static characteristics of places and persons that have thus far escaped attention. For example, variations in the spatial design of shops (Lindegaard, Bernasco, and De Vries 2016) or the organization of crowds during demonstrations (Nassauer 2015) can be easily observed and used to develop specific hypotheses about variations in criminal opportunities. CCTV recordings can also provide knowledge about dynamic characteristics of criminal events that are difficult to reconstruct in retrospective.

Situational transaction theory focuses on explaining crime as related to a chain of interactions between the people involved in the event (Luckenbill 1977). Crime events can be divided into different phases that involve negotiations between offenders, victims, and bystanders. Patterns can be identified in these interactions, for example, in how the offender announces the crime and what follows after the announcement (Luckenbill 1981). Even though a few retrospective studies of crime events succeeded in establishing the causal direction of the behavior of the people involved (Ganpat et al. 2013; Lindegaard et al. 2016; Weenink 2014), CCTV recordings of behavior in crime events are unique for providing a reliable measurement of causal relations between the actions of people involved. Such insights can potentially clarify in what ways the behavior of offenders, victims, and bystanders contribute to the outcome of the crime event, such as the degree of violence and injuries. Furthermore, recordings can shed light on details of this behavior, including the role of body posture and gaze, which may affect the way crime events develop and are potentially prevented (Lindegaard et al. 2016).

Situational crime prevention focuses on how crime can be prevented by changing the situation rather than changing the people involved (Clarke 1995). The aim is to make life as difficult as possible for potential offenders by reducing opportunities for crime. CCTV recordings of crime in action provide potential for getting insights about a range of different variables that may have an effect on the way criminals see opportunities for crime. With large enough sample sizes, recordings of crimes in action can be used as a living lab for testing what kinds of measures may have an effect on criminal behavior.

In sum, CCTV recordings of crime in action can be used both to develop new hypotheses about variables that may be associated with crime and for identifying the mechanisms explaining such associations. They could be particularly useful for refining and test existing situational theories of

crime. In addition, because of their methodological qualities, CCTV recordings of crime in action have the potential of merging qualitative and quantitative approaches to crime and of bringing new life into the waning role of observation in criminology.

Observational Studies in Criminology

Criminology came of age in the era of the Chicago School. Scholars used various methods of data collection, including participant observation, for understanding different types of deviant behavior. Since the positivistic turn in criminology and the imperative for informed consent in the social sciences as enforced by increasingly influential ethical boards (Jacques and Wright 2010), observational methods in general have become distinct (Lindegaard and Copes 2017).

The most common types of observations carried out in criminology are participant observations, researcher observations, and camera observations. These methods differ by the degree of presence of the researcher and the level of systematic analysis carried out based on the data collected. Participant observations are characterized by a researcher who clearly disturbs the object of study by being present and engaging where the action is, whereas researcher observations are characterized by a researcher who observes at a distance from the action, typically noticing behavior according to predefined categories. Camera observations are carried out with a camera. The degree of involvement of the researcher varies depending on what type of camera that is used. Handheld and body held cameras involve a high degree of researcher presence, similar to participant observations, whereas recordings carried out by a car passing by, as in recordings used for "Google street view" or systematic social observations, or by a CCTV camera, involve a low degree of researcher involvement, similar to researcher observations. Researcher and camera observations therefore lend itself better for systematic and deductively driven analysis, whereas participant observations tend to be explorative and inductively driven (Lindegaard and Copes 2017).

Participant Observations

Participant observations have a long history in criminology, but this method is nevertheless only used in less than 1 percent of all research published in top criminological journals in the period 2000 to 2009 (Copes, Brown, and Tewksbury 2011). While a few studies included attention to actual behavior

in the unfolding of criminal events (Goffman 2014; Jacques and Wright 2015; Lindegaard 2009; Venkatesh 2008), the majority of studies based on participant observations provided insights into the lives of people who were involved in crime while the researcher was not there. Studies using participant observations had a major impact on our understanding of crime, because they provided insider perspectives on the motivations for committing crimes, on the personal characteristics of people involved in crime, and on the modus operandi of criminals. The strength of these studies is their potential for clarifying causal directions of variables known for being related, for providing insights into the mechanisms explaining statistical regularities and relations, and for identifying new sorts of influential variables that were unexpected to outsiders. For example, in Elijah Anderson's book *The Code of the Street* (1999), he identified an alternative system to acquire status—referred to as the code of the street—among people living in inner-city areas of Philadelphia. He argued that this code could explain the large statistical probability of young men living in these areas to get involved in both offending and victimization. By providing an insider perspective of people engaging with crime, this book had significant impact on discussions and theory development about culture and crime.

Researcher Observations

Researcher observations with researchers (somewhat less intrusively than in participant observation) situated at some distance from where the action takes place and deductively driven analytical approaches fit better with the positivistic turn in criminology than participant observations. This method was used by researchers studying shoplifting (Buckle and Farrington 1994), drug dealing (Bernasco and Jacques 2015), and aggression in bars (Graham et al. 2006, 2014) and outside bars (Humphreys 1970). It was used to observe characteristics of people engaging in crime (Graham et al. 2006, 2014; Humphreys 1970), physical characteristics of the places known for being high risk in terms of crime (Humphreys 1970; St. Jean 2007), interaction during criminal events (Graham et al. 2014), and modus operandi (Bernasco and Jacques 2015; Buckle and Farrington 1984).

Graham and her colleagues were some of the pioneering scholars using this method to study violence in real-life settings (Graham et al. 1980; Graham and Homel 2008). They sent student assistants to bars to observe thousands of aggressive incidents inside the bar. Students were asked to take note of the characteristics of the people involved, the reasons for the incident, intoxication, and the means for aggression. They found that men were much

more likely to use aggression than were women. Women were more likely to slap others and less likely to push or kick their opponents compared to men. Women were more likely to engage in less severe forms of aggression than were men (Graham et al. 2006:289). By providing insights into aggressive incidents that rarely get reported to the police or referred to in self-report studies, Graham's studies had significant impact on discussions of nightlife violence and the relations between aggression, gender, and intoxication.

Camera Observations

Camera observations are relatively new in criminology. In this special issue, most contributions are based on the analysis of recordings carried out with CCTV cameras. These observations are different from other types of recorded observations because they do not involve a researcher or participant who carries out the recordings. This lack of involvement enables observations of crimes in action without the presence of a potentially disturbing researcher. CCTV camera recordings therefore make observations of crime in action less ethically problematic than recordings with other types of devices because the researcher is unable to influence the course of events during the crime due to the full exclusion from the situation.

Other types of recorded observations involve the presence of a researcher, more or less removed from the observation (car held, handheld, or body held) or in the case of body worn cameras (BWC), often a law enforcement person. The presence of an observer makes these types of recordings ethically problematic in studies of crime in action. Therefore, they have also most commonly been used to observe different aspects of physical and social disorder—not of crime in action— associated with various types of crime (Sampson and Raudenbush 1999). Similar types of analyses have been conducted with the use of Google street view (Tabb, Ballester, and Grubesic 2016; Vardalis and Cox 1998).

Systematic social observation is a set of methods in which observation and recording of social phenomena in their natural settings are conducted following explicit procedures which permit replication (Mastrofski, Parks, and McCluskey 2010). Cameras can be very useful in research involving systematic social observation. Although crimes are rarely captured on camera, indicators of social disorder can be observed and recorded frequently. In a study combining systematic social observations, more specifically recordings made of 23,000 street segments in Chicago, with self-report studies and official crime statistics, Sampson and Raudenbush (1999) provided strong evidence in support of their theory that crime is associated with

low levels of social efficacy rather than with observed social and physical disorder.

Use of Camera Recordings in Other Disciplines

Video analysis is common in a range of different scientific disciplines. In what follows, we will elaborate on how camera recordings have been used and have advanced knowledge in the fields of linguistics, anthropology, sociology, psychology, and biology. While our elaboration is far from complete, we conclude that video analysis has contributed to these scientific fields for two main reasons. The first is that it has offered the possibility for systematic analysis. The second is that it has provided insights into aspects of behavior that were unknown before they were caught on camera, for example, because video footage can be rewound and be played back in slow motion.

Linguistics

By being able to rewind the observed matter, the advantages of video recordings for scientific purposes are similar to those of audio recordings as remarked by the linguist Harvey Sacks (1984) who started using audio recordings in the early 60s:

> I started to work with tape-recorded conversations. Such materials had a single virtue, that I could replay them. I could transcribe them somewhat and study them extendedly—however long it might take. The tape-recorded materials constituted a good-enough record of what happened. Other things, to be sure, happened, but at least what was on the tape has happened. It was not from any large interest in language or from some theoretical formulation of what should be studied that I started with tape-recorded conversations, but simply because I could get my hands on it and I could study it again and again, and also consequentially, because others could look at what I had studied and make of it what they could, if, for example, they wanted to be able to disagree with me. (p. 26)

Through the tape recorder, new avenues for research emerged that had been impossible before the technical possibility of recording and rewinding the object of study. Together with colleagues, Sacks (1973) identified how naturally occurring conversations are structured into reciprocal systems of turn takings. Audio recordings became a means of accessing naturally occurring conversations, not staged and not disturbed by an observing researcher. These new types of scientific data brought about the scientific

field of conversational analysis, also referred to as the "study of talk-in-action" (Psathas 1995). As Sacks remarked, audio recording provided him with a "good enough" perspective of what happened even though the recorder of course only partly captured what happened. Another advantage of audio recordings was the ability to store raw data and thereby allow the analysis to be done by multiple researchers.

The introduction of video recordings in linguistics brought attention to the importance of nonverbal cues for conversational structure (Beattie 1983). Video recordings provided data that not only could be systematically analyzed but also provided access to information about nonverbal communication that previously had been inaccessible.

Anthropology

In anthropology, video recordings played an important role in conducting ethnography as early as the beginning of the twentieth century. An example is the 1914 ethnographic film by Edward S. Curtis documenting "The Land of Head Hunters" in Canada. The driving force of using a camera was not primarily scientific. Rather, the purpose was to document the lives of the people studied for exposure, as video provided a way to educate the public about other cultures.

With the relativistic turn in anthropology, this role of the researcher as the director of ethnographic films disappeared. Instead, with the camera, research participants were able to provide "emic" perspectives—the natives' points of view (Malinowski 1948) on their lives, perspectives that were inaccessible when the researcher did the recordings. In that sense, the video camera became used as a means of becoming a "fly on the wall"—not an invisible fly—but a fly that was more of an insider than researchers tend to be (Knoblauch 2005). Anthropologists rarely used video recordings with the motivation of getting access to undisturbed behavior. Video recordings were not perceived as providing access to some form of objectively or naturally occurring phenomena but as a means of accessing one out of many subjective realities produced under specific types of circumstances. In fact, anthropologists have used the camera as a means of communication rather than as a means of observation.

Sociology

The anthropological approach to video recordings as inherently subjective differs from the interpretative video analysis that has been used in

sociology. Interpretative video analysis uses video recordings as a means of getting access to relatively undisturbed forms of interaction. This analysis has been strongly influenced by ethnomethodological traditions in conversational analysis with its focus on "sequential analysis" (Knoblauch and Schnettler 2012). Video recordings are used to provide insights into "interaction ethology" (Goffman 1971) as played out in naturally occurring microsettings. These orders emerge in situations where people share a common focus. Therefore, they have also been referred to as "focused forms of interactions" (Goffman 1967). Video cameras are typically put in places where "the action is" with the people being observed being notified about the presence of a camera. Analyses in this tradition using video recordings have provided insights in how people who feel solidarity with each other tend to move in synchrony (McPhail and Wohlstein 1982), in how accidents on highways tend to be caused by the distraction of bill boards (Beijer, Smiley, and Eizenman 2004), and in how biking behavior differs across countries (Aluvihare, te Brömmelstroet, and van der Horst 2014).

Psychology

In psychology, video recordings have played a crucial role in the analysis of behavior in both experimental and nonexperimental settings (Graham and Homel 2008). Different from sociology that used video recordings to study relatively undisturbed behavior in real-life or access aspects of that behavior invisible to the human eye, psychologists predominantly used video recordings to stage circumstances in experimental setups and to record reactions for further analysis. For example, reactions were recorded for infants and mothers placed in different kinds of emotional stress in experiments (Graham et al. 1980) and marital couples exposed to different questions (Mastrofski et al. 2010).

Video recordings were included in a virtual a reality experiment about bystander intervention both as a means of staging the experimental circumstances those respondents were exposed to and as a means for recording their responses (Slater et al. 2013). Other studies in psychology used recordings of real-life behavior in nonexperimental designs. For example, video recordings of behavior in real-life situations were used in studies of interactional cues of autism in early childhood (Baranek 1999), interactions between students and teachers in the classroom (Mehan 1979), and the way children respond in the aftermath of conflicts with peers in daycare facilities (Ljungberg, Westlund, and Lindqvist Forsberg 1999).

Biology

In biology, cameras are used to study animal behavior both in experimental setups and in real-life captivity or in the wild. Where animals are held in captivity, cameras can be mounted at fixed positions where they capture the complete habitat, a situation comparable to the use of security cameras in stores and other retail businesses. In the wild, it is more complicated to observe animal behavior and to capture it on camera. Camera traps have been used widely to count animals for estimate population sizes, but they usually only take photographs and do not record footage of behavior.

Miniaturization of the camera has created opportunities to make nonobtrusive recordings at places that used to be impossible to monitor before the technological innovations, for example, in holes under the ground, in birds' nests, and under water.

According to Wilmers et al.'s (2015) recent innovations of camera, technology advanced animal ecology significantly, by answering questions about the physiology, behavior, and ecology of wild animals in their natural environment that previously would have been limited to tests on model organisms in highly controlled settings.

More insights were obtained about cryptic or wide-ranging animals that previously evaded investigation. This led to the development of new theories and tests of both existing and new theories. For example, cameras were used to study how penguins move their head in order to catch krill (Watanabe and Takahashi 2013) and to investigate interactions among seals (Mitani et al. 2010).

Prior Studies of Crime on Camera

The studies presented in this special issue are not the first ones making use of CCTV camera recordings of crime. In his book on violence, Collins (2008) advocated for more video analysis of actual incidences of violence because videos can capture issues of timing which are crucial for understanding violence: "the occurrence of violent events depends on its timing in relation to other such events, as well as in the internal flow of timing in micro-incidents" (p. 35). In his own analysis of violence, however, he mainly relied on still photos because of their ability to "catch emotion and show details of bodies in space" (Collins 2008:30). The contributions to this special issue exactly used CCTV footage to go into such details about emotions and body postures, but the first studies of crime based on CCTV footage rarely incorporated such details about the interaction in crime events.

In the field of criminology, one of the pioneering studies using CCTV footage was by Dabney et al. (2004) who used recordings taken in a suburban retail drug store in the United States to study shoplifting. Their findings questioned some widely held stereotypes about shoplifting. For example, middle-aged women were more likely to be observed shoplifting than would be expected based on their proportion in official crime statistics. A study based on CCTV footage that addressed the issue of offender profiling was conducted by Jobard and Lévy (2011). They studied actual behavior of police officers during identity checks in Paris. By being able to include attention to both people who were selected and not selected during these checks, their study provided powerful evidence that police officers overstopped and searched young men dressed in youth culture style, and that within these categories, they overstopped and searched ethnic minorities.

In studies of violence, Levine, Taylor, and Best (2011) used CCTV footage of street fights. Their focus was on the role of bystanders in escalating and de-escalating conflicts. They found that contrary to results from experimental studies, bystanders were much more likely to intervene in violent conflicts than suggested by the "bystander apathy" paradigm (Levine et al. 2011). Furthermore, if bystanders intervened, they generally managed to calm down the aggressors and avoid escalation. Another study of bystanders based on CCTV footage of robberies showed that bystanders play a crucial role not only in the course of commercial robberies (Lindegaard et al. 2016) but also after the offenders have left the scene (Lindegaard et al. 2017). They take an active role in consoling the victims by physically touching them, which is known to have a stress reducing effect. The findings demonstrate that women are more likely than men to provide consolation and that social proximity between victim and bystander (in this case between employees of the targeted business) facilitate consolation.

CCTV footage was also used in studies of less common phenomena such as genocide (Klusemann 2012) and demonstrations (Nassauer 2015). These studies were concerned with sequential patterns of interactions in the course of the crime event, including the very moment where a conflict turned into violence. Both studies found that in events where violence took place, a certain pattern lead up to the moment of escalation. The moment one party managed to establish dominance, tension was released and that was the moment that escalation into violence took place (also see Collins 2008). A few studies of drug dealing also made use of CCTV footage, providing detailed descriptions of seller behavior across time and space (Piza and

Sytsma 2016) as well as the temporal distribution and size of drug transactions (Moeller 2016).

These pioneering studies about crime based on CCTV footage are remarkable because of the degree of detail they provide into the behavior during crime events. Some of them provide insights that we simply had no knowledge of before (Dabney et al. 2004; Lindegaard et al. 2017), and some refine already existing theories (Jobard and Lévy 2011; Klusemann 2012; Levine et al. 2011; Moeller 2016; Nassauer 2015; Piza and Sytsma 2016).

While one of these studies used a fairly large sample size (Dabney et al. 2004), the others and the ones included in this special issue tend to use relatively small sample sizes. Furthermore, there is a tendency to do inductively driven and qualitative analyses of the data, focusing on complexity and detail rather than on quantifying and generalization. We propose that this tendency is not necessarily related to the nature of the data but to the nature of the currently available tools for analysis. The high degree of complexity of these data, the fact that we can measure behavior as related to specific actors in place and time, makes data reduction and modeling difficult. We believe that these data are promising because they can help to building bridges between the currently often distinct qualitative and quantitative approaches in criminology (Miller 2005), but more methodological development is required for this to happen. In Weber's terms, observations with CCTV camera footage are currently mainly used for *understanding* (verstehen) the mechanisms underlying the actions observed, through analyses focusing on "thick descriptions" of behavior in a limited amount of criminal events. However, these data can also be used for *explaining* (erklären) these mechanisms through statistical analyses of large-scale samples. Compared to previous observational methods carried out within criminology, this ability for different types of analytical approaches is unique.

Lessons Learned

In this concluding section, we formulate a number of key insights. In doing so, we will draw extensively from the six contributions that we selected to publish in this special issue, as they represent the state-of-the-art in contemporary research on crimes caught on camera. Because the field has only recently started to gain some momentum, we take the freedom to use these lessons for making recommendations on new research topics and on methodological challenges that could be addressed in future research.

Lesson 1: Cameras Capture Some Crimes More Than Others

One of the most obvious conclusions about using cameras to observe crime is that some types of crime are much easier to catch on camera than others. Apart from the fact that some crimes are rare (e.g., arson) while other are common (e.g., shoplifting), there seem to be two reasons for crime-type selectivity. The first reason is that the most common sources of video footage are surveillance and security cameras, and these cameras tend to be located in public space or in semipublic facilities like public transportation vehicles and stations, retail businesses, hotels, and sports venues. Consequently, crimes caught on camera rarely feature crimes that normally take place in other settings. For example, burglary, domestic violence, or rape are seldom caught on camera, as they usually take place in residential rather than public settings. The second reason for camera selectivity is that cameras can only identify crimes with visual behavioral elements. There are certain types of criminal behavior that would not be visible on camera recordings because they do not necessarily involve suspicious visual cues, for example, fraud in financial transactions or computer hacking activities. In order to be useful for analysis of crime, the type of crime needs to include clear visual behavioral cues to distinguish illegal from legal behavior.

Contributions to this special issue illustrate that available video footage is limited to specific types of crime at specific locations. Two contributions investigate commercial robberies in retail businesses and other semipublic places (Mosselman, Weenink, and Lindegaard; Nassauer). The video material analyzed in these studies had been recorded by security cameras in the targeted premises. In both contributions, the analytical focus is on the interactions between offenders and victims in situations where offenders force victims to act against their will under the threat of potentially lethal violence. Analyses would not have been feasible for similar types of offender–victim interactions that are much less likely to have been captured on camera, such as rape or street robbery. In the latter case, it is only the location itself (outdoor versus indoor) that defines the crime as being eligible or not for inclusion in a study of recorded crime footage.

Two other contributions used footage on public violence between citizens (Liebst, Heinskou, and Ejbye-Ernst in this issue) and between police officers and citizens (Willits and Makin in this issue), while still two others used video footage of transactions between drugs sellers and buyers in open air drug markets (Moeller in this issue; Sytsma and Piza in this issue). With the exception of the study by Moeller, which stands out because the cameras were mounted both outdoors and indoors by the police as part of a criminal

investigation, the events analyzed in these papers had all been recorded by surveillance cameras in public space. Surveillance cameras in public space are less selective when it comes to the types of crime or incidents that are being recorded. As a result, a wide array of video-recorded crime is available. For example, the contribution by Liebst et al. studies the risk of victimization of bystanders who intervene in an ongoing fight. Another recent study used video recording to investigate consolation behavior between bystanders and victims in the aftermath of commercial robberies (Lindegaard et al. 2017).

Public violence and public drug dealing could only become the key topics of these articles because they are incidents that frequently take place in public spaces in the view of cameras. The lesson is that until cameras have become commonplace inside our homes, domestic violence, indoor drug trading, or burglary will not be caught on camera, and these crimes will continue to escape observational studies.

Recommendation 1: Study Different Crimes, Settings, and Actors

We propose to widen, as much as possible, the set of crime types to be studied. This would include, in addition to robberies and assaults, crimes like pickpocketing, terrorism, lethal violence, group violence, and sexual assault. We would also emphasize the need to investigate different settings, including public transport, schools, factories, offices, hospitals, prisons, and public departments. Many such settings have security cameras installed. We also encourage studying the behavior of different actors involved in the crime, including not only offenders, victims, and bystanders but also police officers and other formal guardians involved in surveillance or law enforcement.

Attention to different types of crimes, settings and actors can provide insights into whether findings are conditional on the crime type. For example, keeping calm as offender in a street robbery may ensure control whereas the same behavior in a shop robbery may encourage victims and bystanders to resist. Insights about different settings can provide better understandings of, for example, how closed versus open spaces may influence bystander behavior or the way a counter in a shop may influence offender behavior. Insights about different actors provide better understandings of, for example, whether the presence of law enforcement officers influences the risk of escalation differently than the presence of informal guardians.

We further propose using camera recordings to study how law enforcement officers interact with citizens in tense situations more generally.

Camera recordings are particularly useful for such sensitive topics because they provide a relatively objective perspective on actual occurrences.

Lesson 2: Selection Bias Is a Major Challenge

To a naive observer, one of the most puzzling aspects of crime being captured on camera might be that many offenders commit crimes in front of a camera while presumably being aware that they are being filmed. As a researcher with access to video-recorded crime, one should ask the question how unobtrusive and nonreactive cameras actually are. Biologists studying ants or birds may assume that a camera will not affect the observed behavior of the animals (especially if the camera is mounted and human observers are not present), but this is less true for human behavior. The extent to which cameras are reactive will likely depend on their location, visibility, and salience. The BWCs of police officers that are used in the contribution by Willits and Makin are likely more salient and reactive than CCTV cameras mounted on buildings or lampposts, and thereby more strongly affect how police officers and citizens behave in disputes. In contrast, the CCTV cameras providing the footage used in the contribution by Moeller had been covertly installed by the police with the aim of assessing the volume and value of the drugs being traded. The presence of these cameras could not affect the behavior of drug sellers and buyers unless they were aware of them.

If potential offenders are aware of the presence of cameras, it will possibly affect their behavior. In line with their main purpose, cameras may deter prospective offenders and thus prevent the crimes they would have committed without the presence of the camera. It could, however, also not prevent the crime but merely affect how and where it is committed. A robber may, for example, dress to remain unrecognizable. It is also likely that some offenders (e.g., robbers, drug dealers, or pickpockets) avoid committing their illegal actions in view of a camera and displace their crimes to premises or locations outside the view of cameras. In that case, the crimes recorded on camera are only those that are committed by the most ignorant, careless, or impulsive offenders. However, empirical evidence on bank robbery (an offense more likely to be premediated and planned than other offenses) suggests that CCTV cameras do not deter offenders and even that many offenders are hardly concerned or think about the presence of cameras at all (Gill and Matthews 1994; Vardalis and Cox 1998).

Recommendation 2: Study Selection Bias of Camera Recordings

We suggest that researchers include attention to the selection bias of their study and carry out investigations of the way their sample is biased. Liebst et al., Mosselman et al., Moeller, and Willits and Makin in this special issue rely on recordings provided by the police. Currently, it is unclear what kinds of criminal events get recorded and included in police case files, and more importantly, what kinds that avoid such scrutiny. We propose investigating the whole process of producing the camera recordings included in police case files, including finding out how decisions are made about where to put cameras, what kinds of incidences that get recorded, how the recorded footage is transferred from control room or shops into the police case files, and how the recordings become incorporated in investigations. For example, in order to identify sample biases of recordings of robberies provided by the police, we need to know what kinds of shops install cameras, what kinds of recordings get stored, and why the police keep the full footage in some cases while reducing it to still photos in others (Lindegaard et al. 2016).

Nassauer's contribution in this special issue relies on recordings uploaded to the Internet. The process of uploading videos to the Internet is even more unclear than including videos in police case files. For these data to be useful for crime research, more effort needs to be made in finding out what kinds of crimes get recorded, how videos get uploaded, who is doing it, and with what purposes. For example, it is our impression that video recordings of robberies are more likely to end up on the Internet if offenders fail and if victims or bystanders are able to prevent successful completion of the robbery. Using videos of robberies on the Internet as a data source is therefore potentially problematic (Lindegaard et al. 2016).

For the research field of crime caught on camera to develop its fullest potential, we propose taking the selection bias problem seriously. We recommend including attention to questions about awareness of cameras and potential adaptation in behavior to cameras in such investigations.

Lesson 3: Cameras Miss Some but Capture Other Aspects of Crime

The contribution by Mosselman et al. is an example of the kinds of insight into weapon use that could be gained by analyzing crime caught on camera. Prior research had demonstrated that weapons affect criminal event outcomes but we did not know *how* they do. Mosselman et al. show that guns are only effective if combined with the "right" body postures. Guns alone

do not prevent offenders from using violence. The study shows that guns are only efficient for violence prevention in robberies if used in combination with dominant body postures. In other words, it is not the guns but the combination with body postures that ensure victim compliance. We expect that camera recordings will be helpful for similar types of studies of *how* variables such as gun presence, known for their significance, matter for criminal event outcomes.

The contribution by Willits and Makin to this special issue uses an unconventional source of video footage, namely, the BWC, a device increasingly used in many police departments in the United States and elsewhere (Lum et al. 2015). To our knowledge, all prior research using the BWC is about its effect on the behavior of police officers and citizens, but not on the content of what is actually caught on the BWC. Because the BWC is mounted on the uniform of the police officer, it produces video material from the officer's perspective, and the footage follows his or her movements. This creates a "personalized" recording that deviates strongly from the objective viewpoint of CCTV cameras that are often fixed at positions where they cannot be reached easily. The recorded BWC footage excludes a view on the police officer who is wearing the BWC, but it might include a view on his or her colleagues.

Despite our enthusiasm about the possibilities of collecting and analyzing crimes caught on camera, crime footage as we know it is limited for a number of reasons. First, footage rarely includes verbal communication. Although allegedly at least 70 percent of human communication is nonverbal (Birdwhistell 1970), this is still a serious limitation because verbal communication tends to provide cues about the meaning of the behavior caught on camera. Thus, we do not hear how robbers address their victims and vice versa, we cannot hear what buyers and sellers talk about when making a drugs deal or what the communication between police officers and citizens is about when they engage in a violent confrontation. Without cues about meaning making, interpreting the behavior on the recordings may be more difficult.

Second, even though researchers have developed strong evidence for the interpretation of body postures and actions caught on camera, this field of research is less developed than the broader field of facial expressions. In order to develop more sensitive measurements of the behavior recorded, we need a better understanding of the meaning of the behavior as experienced by the people caught on camera. Camera recordings provide little insights into motivations and subjective experiences, which we know to be important for explanations of crime (Jacobs and Wright 1999).

Third, camera recordings of crime tend to be fragmented. They typically provide limited angles on the interaction studied because of a particular composition of the cameras. They tend to only capture a part of the interaction since the people doing the recordings typically leave out aspects that only researchers may be interested in, for example, consolation behavior in the aftermath of the event (Lindegaard et al. 2017). In addition, the quality of the recordings can be a problem, particularly when it is dark. Even though surveillance cameras tend to be of high quality, they are generally still not good enough for the analysis of facial expressions.

Recommendation 3: Attempt to Control Cameras and Footage and Triangulate

We propose that whenever possible, in order to reduce bias and unwanted selectivity, researchers attempt to gain some level of control over what is recorded on camera, how it is recorded, and which parts of it are saved and selected for the analysis.

All six studies reported in this special issue rely almost completely on footage selected by law enforcement. The selection will usually be made for investigative purposes, which may not necessarily align with the aims of the research. For example, researchers might be interested in observing counterfactual situations where drug transactions are *not* made, robberies are *not* committed, and violence does *not* escalate, but the police or the camera owners are less likely to select and save footage of counterfactual situations because it would not directly serve their purposes. If this is the case, researchers are advised to engage with the police or owners of the camera to negotiate access to complete unselected and unedited footage. Although it obviously generates a time-consuming observation and selection task for the researcher if such access is granted, it provides much better control over the selection of material. In some situations, in particular those where researchers are involved in the assessment of the utility of CCTV for authorities of business owners, they may have a say in where cameras are being installed and maybe also on the types of camera and whether sound recording is included.

To reduce bias and unwanted selectivity, we suggest to combine camera recordings with other sources of data, such as police case files and interviews. First, including information from others sources helps researchers in interpreting the interaction on the video by providing alternative perspectives on the actions observed. These perspectives enable the researcher to develop more accurate and valid interpretations and coding. Second, other

sources potentially provide additional information on elements of the interaction not visible in the recordings. For example, information about motivations or about preexisting relationships between the people on the footage could be relevant but unobservable in the recordings. Thus, researchers should not myopically focus on video recordings, and we strongly recommend triangulating recordings with data from other sources.

Lesson 4: Coding, Quantification, and Analysis Are Developing

Based on the contributions to this special issue as well as on prior studies, the analytical strategies that are used in the study of crime caught on camera are relatively simple and straightforward. In most if not all of the contributions to this special issue, and in prior studies as well, it appears that the coding only scratches the surface of the materials that can be observed in visual data. Most papers do not use particularly detailed coding schemes but include only the essential variables that make up the research question. While without doubt this reflects the substantial costs involved in coding video materials, it occasionally also makes the reader wonder whether enough detail has been harvested from the very rich crop. It is not uncommon, for example, to code criminal events as a single case (i.e., as the unit of analysis) rather than individuals or subsets of individuals. For example, a robbery can be coded by noting whether a weapon was available, whether violence was used, whether resistance was encountered, or how many bystanders were present. In video footage, however, much more detail is actually available. Instead of coding the availability of a gun, it could be relevant what type of gun it is, who is carrying it, whether it is only shown, or whether it is also used as a direct threat by pointing it to victims (and to whom), and so on.

In addition, criminal events unfold over time. Most behavior is dynamic and each action takes place at a specific moment in time. While some of the contributions take into account the temporal dimension of the video material, in general time, duration, and the sequence in which actions take place do not receive much focus. Again, it appears that authors struggle with the comprehensiveness of the visual data and maybe with its lack of inherent structure. Like the material from ethnographic data collection methods, such as researcher observation and participant observation, crime footage is erratic and unstructured, whereas alternative data sources like police case files, self-report surveys, and interviews typically have more structure and are more easily molded into the quantitative framework that many researchers in criminology are familiar with.

Recommendation 4: Study Reliability and Develop Automated Coding

We recommend that all studies drawing on camera recordings for analysis of crime include detailed attention to the reliability of their measurement of behavior caught on the camera. Only two of the six studies reported in this special issue carried out some form of intercoder reliability tests (Liebst et al.; Sytsma and Piza). Intercoder reliability tests should be standard practice though to help verify the validity of the conclusions.

Additionally, we propose documenting in detail the complicated process of developing coding schemes, e.g., how certain codes were more reliable than others, and in what ways the initial phase of coding dealt with these issues. We recommend that researchers allow for detailed inductive coding before moving on to more deductively driven processes of coding. The inductive part of the process is tempting to jump over, because it is highly time-consuming and can be confusing at times. We recommend that researchers carry out this part of the coding process with multiple researchers together in continuous dialogue, preferably watching videos together while interpreting, and at the same time systematically and in great detail documenting decisions made in the process. Only when this process has been finalized, is it advisable to apply the coding on larger samples and eventually carry out statistical analysis of the outcomes.

Eventually, the process of systematic inductive coding across studies could lead to the development of detailed automated coding that will enable researchers to carry out analyses of sample sizes that are much larger than what is currently feasible. Researchers in *social signal processing* (Datta, Shah, and Lobo 2002; Ge, Collins, and Ruback 2012; Vinciarelli, Pantic, and Bourlard 2009) are currently developing automated measures of movements, postures, and rhythms, some of which are actually difficult to detect by human observers (McPhail and Wohlstein 1982). We encourage criminologists to work together with computer scientists to further develop these methods and apply them to video material of criminal behavior.

Lesson 5: Video-based Research Can Be Replicated

Criminology is a discipline where due to restrictions imposed by data owners original raw data are rarely made public and are seldom shared between researchers. Although there are often good reasons for this state of affairs, it is increasingly problematic in a time where several disciplines have been described as being in a "replication crisis" and researchers are

increasingly required to make the process of scientific discovery more transparent, often by making their data public and accessible to colleagues or the general public. Video material includes many details about people and places. Because it is not easy to conceal the identity of these persons and these places, the material is difficult to share. Typically, raw video material cannot be shared between researchers and can certainly not be made publicly accessible. The contribution by Nassauer is an example of what "open science" based on CCTV footage could look like in criminology if we are to use the public footage of crime available on the Internet. She explains in detail the requirements that the clips she used had to fulfill in order to be eligible for inclusion in her study. Her paper also lists the locations of these 20 clips on the Internet, together with some of the attributes that were assigned to the clips after watching them, and her coding scheme. This strategy makes it possible for anyone with access to Internet to reproduce the data and replicate the reported study. Although the risk of selection biases is present in publicly available video material, it allows a form of open science that is yet uncommon in criminology.

A comparison with the data used in the contribution by Moeller is illustrative. The CCTV cameras in Moeller's study had been covertly installed by the police with the aim of assessing the volume and value of the drugs being traded and were watched and transcribed by police personnel. Moeller himself did not have access to the footage but had to rely on the observations and transcripts by the police. In this particular case, where the estimation of sales volumes and prices was the main purpose, this setup seems acceptable despite the fact that the research cannot easily be replicated. When research questions are complex and multilayered, it may not work successfully because police officers are not trained in scientific research, if they would be allowed to spend much time on it in the first place.

Recommendation 5: Replicate Studies and Carry out Comparisons

We recommend that researchers share video recordings, pool data, and replicate sample selections and coding schemes in order to carry out comparisons. Video recordings allow researchers to replicate all steps of the research process including the process of measurement through inductively driven coding and hypotheses. In ethnographic fieldwork or qualitative interviews, this part of the process tends to be unique to the researcher collecting the data.

Video recordings are potentially easy to share among researchers, but there is a need of ethically sound practices for ensuring accessibility of recordings. Even though Internet sources at first sight are perfect for data sharing, videos frequently disappear from the Internet. With videos provided by the police, data sharing is generally restricted to specified people directly involved in the project.

Video recordings of crime are ideal for comparative studies, but such comparisons require better quantification of findings. Video recordings are unique for providing insights into real-life behavior in specific events. To avoid getting caught up in the particularity of specific cases, sharing of data, measurement instruments, and analytical techniques are crucial.

Lesson 6: Video-based Research Must Be Learned

Video-based research is a new practice in the study of crime and law enforcement, and very few criminologists have received any formal training in how to set up research using CCTV materials. We know this applies to all contributors to this special issue, who are autodidacts in video-based research. Although some authors had some prior experience in using video materials (Lindegaard et al. 2016, 2017; Moeller 2016; Nassauer 2015, 2016; Piza and Sytsma 2016), they did not have formal training in using CCTV footage.

While some of the experiences with video material in other disciplines briefly reviewed earlier in this essay can prove helpful, a recent paper by (Nassauer and Legewie 2016) could also provide researchers in the social sciences with useful general recommendations and practical guidelines for setting up research with videotaped data. The article includes a comprehensive discussion of the variable types that can be studied with video data, of the coding process, and of analytical procedures available. Moreover, it provides practical guidelines for setting up the research and for collecting, evaluating, and analyzing data.

Recommendation 6: Learn from Biology and Other Disciplines

We propose that researchers draw on experiences with observational methods from other scientific disciplines. For issues of measurement and interpretation of human behavior, they could draw on insights from psychology, where body postures, movements, and the expression of emotions have been extensively studied in the laboratory. For issues of observing behavior in uncontrolled real-life situations, we suggest they turn to biology.

Contrary to the behavioral sciences of humans, biology has developed a strong tradition in observational methods for real-life situations (Verbeek 2008), although admittedly much research is on animals in captivity. Without being able to observe verbal communication between animals, behavioral biologists have developed meaningful ways of studying animal behavior. Their observational studies involve high levels of transparency, inductively driven and systematic analysis, and sound analytical techniques. We propose that criminologists interested in studying crime caught on camera seek inspiration from behavioral biology or other disciplines with a strong tradition in observational methods.

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